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Chen-Hsun (Jay) Chan

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Education

PhD in Physics **Sept 2017 - May 2023**
University of Wisconsin-Madison

Dissertation: *"Investigation of Higgs Boson Decaying to Di-muon, Dark Matter Produced in Association with a Higgs Boson Decaying to b-quarks and Unbinned Profiled Unfolding"*

Master of Science in Physics **Sept 2013 - Jul 2015**
National Tsing Hua Unicersity

Thesis: *"Dark Matter Induced Mikheyev-Smirnov-Wolfenstein (MSW) Effects in the Sun and in Core-Collapse Supernovae"*

Bachelor of Science in Physics **Sept 2009 - Jun 2013**
National Tsing Hua Unicersity

Professional Experience

Machine Learning Postdoctoral Research Fellow **June 2023 - Present**
Scientific Data Division, LBNL | Dr. Paolo Calafiura *Berkeley, CA*

- Developing a deep learning pipeline (using Graph Neural Network) to measure particle trajectories in High-Energy Physics detectors.
- Developing a generative model of hadronic interactions and tune it to Geant 4 and experimental data.
- Developing ML-based unfolding algorithms for particle physics.

Visiting Researcher **Sept 2022 - May 2023**
Machine Learning Group, LBNL | Dr. Benjamin Nachman *Berkeley, CA*

- Developing novel ML applications for particle physics, including data unfolding and event simulation with generative models; contributed to 3 projects with 2 first author journal publication.
- Translated abstract ideas into efficient and well-documented code using PyTorch, TensorFlow and Jupyter Notebook; successfully demonstrated proposed methods with practical examples.

Visiting Researcher **Sept 2021 - Aug 2022**
ATLAS Group, LBNL | Dr. Maurice Garcia-Sciveres *Berkeley, CA*

- Designed experiments and troubleshooting to validate the ATLAS ITk pixel modules and readout chips.
- Performed extensive electrical tests on pre-production (ITkPixV1.1) modules and chips with promising results, leading to submissions of module pre-production and chip production.
- Developed three robust 0-1 software tools using Python and C++ to automate the pixel module QC test procedure (interacting with hardware instruments, YARR and production database); successfully implemented and in use across several leading institutions, including ANL, LBNL, and SLAC.

PhD Researcher **May 2018 - Aug 2021**
CERN | Prof. Sau Lan Wu *Geneva, Switzerland*

- Led 4 physics analyses of the ATLAS experiment focused on Higgs physics and Dark Matter; presented 5 approval talks, resulting in 4 journal papers and 4 ATLAS conference notes.
- Developed ML-based event categorization and enhanced signal sensitivity by over 200
- Developed statistical framework and performed statistical fitting; delivered statistical results as well as visualization plots.
- Applied anomaly detection using unsupervised machine learning methods (e.g. VAE) and demonstrated the methods by re-discovering the Higgs boson from the ATLAS data at over 10 standard deviations.

Research Assistant **Jul 2013 - Jun 2017**
NTHU *Hsinchu, Taiwan*

- Created a Machine Learning method to improve discrimination of Higgs boson production modes.
- Estimated Dark Matter distribution numerically in astronomical objects (Sun, supernovae and the Galaxy) and calculated impacts of Dark Matter on neutrino oscillations assuming Dark Matter-neutrino interactions; set 2 times stronger constraint on Dark Matter-neutrino coupling strength.
- Studied 214 p-wave superconductor with the molecular beam epitaxy System (MBE).

Publications

I am an coauthor of 184 papers of which 174 are published in peer reviewed journals as a member of the ATLAS Collaborations. The full list can be found at:

https://inspirehep.net/authors/1605504.

Below highlights only the publications which I have made key contributions. In experimental high energy physics it is conventional to list all authors alphabetically regardless of specific contribution.

Refereed Journal Articles

[1] The ATLAS Collaboration (Coauthor), "Combination and summary of ATLAS dark matter searches interpreted in a 2HDM with a pseudo-scalar mediator using 139 fb^{-1} of $\sqrt{s} = 13$ TeV pp collision data," [arXiv:2306.00641 [hep-ex]].

[2] **J. Chan**, X. Ju, A. Kania, B. Nachman, V. Sangli and A. Siodmok, "Fitting a Deep Generative Hadronization Model," [arXiv:2305.17169 [hep-ph]].

[3] **J. Chan**, "Investigation of Higgs Boson Decaying to Di-muon, Dark Matter Produced in Association with a Higgs Boson Decaying to b-quarks and Unbinned Profiled Unfolding," [arXiv:2305.19436 [hep-ex]].

[4] **J. Chan** and B. Nachman, "Unbinned profiled unfolding," Phys. Rev. D **108**, no.1, 016002 (2023) doi:10.1103/PhysRevD.108.016002 [arXiv:2302.05390 [hep-ph]].

[5] The ATLAS Collaboration (Coauthor), "A detailed map of Higgs boson interactions by the ATLAS experiment ten years after the discovery," Nature **607**, no.7917, 52-59 (2022) [erratum: Nature **612**, no.7941, E24 (2022)] doi:10.1038/s41586-022-04893-w [arXiv:2207.00092 [hep-ex]].

[6] The ATLAS Collaboration (Coauthor), "Search for dark matter produced in association with a Standard Model Higgs boson decaying into b-quarks using the full Run 2 dataset from the ATLAS detector," JHEP **11**, 209 (2021) doi:10.1007/JHEP11(2021)209 [arXiv:2108.13391 [hep-ex]].

[7] The ATLAS Collaboration (Coauthor), "A search for the dimuon decay of the Standard Model Higgs boson with the ATLAS detector," Phys. Lett. B **812**, 135980 (2021) doi:10.1016/j.physletb.2020.135980 [arXiv:2007.07830 [hep-ex]].

[8] **C. H. Chan**, K. Cheung, Y. L. Chung and P. H. Hsu, "Vector Boson Fusion versus Gluon Fusion," Phys. Rev. D **96**, no.9, 096009 (2017) doi:10.1103/PhysRevD.96.096009 [arXiv:1706.02864 [hep-ph]].

ATLAS Conference Notes

[1] "Combined measurements of Higgs boson production and decay using up to 139 fb^{-1} of proton-proton collision data at $\sqrt{s} = 13$ TeV collected with the ATLAS experiment," [ATLAS-CONF-2021-053].

[2] "Combination and summary of ATLAS dark matter searches using 139 fb^{-1} of $\sqrt{s} = 13$ TeV p p collision data and interpreted in a two-Higgs-doublet model with a pseudoscalar mediator," [ATLAS-CONF-2021-036].

[3] "Search for Dark Matter produced in association with a Standard Model Higgs boson decaying to b-quarks using the full Run 2 collision data with the ATLAS detector," [ATLAS-CONF-2021-006].

[4] "A search for the dimuon decay of the Standard Model Higgs boson in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS Detector," [ATLAS-CONF-2019-028].

ATLAS Public Notes

[1] "Expected tracking and related performance with the updated ATLAS Inner Tracker layout at the High-Luminosity LHC," [ATL-PHYS-PUB-2021-024].

[2] "Dark matter summary plots for s-channel and 2HDM+a models," [ATL-PHYS-PUB-2021-045].

Awards

2023 Two Sigma PhD Fellowship, nominated by Physics Department Chair, UW-Madison	**Nov 2022**
Research Fellowship, Machine Learning for HEP, LBNL	**Sept 2022**
Research Fellowship, ITk Pixel Upgrade, LBNL	**Sept 2021**
US-ATLAS Center (ATC) Funding Award, ITK Pixel Upgrade, US-ATLAS	**Sept 2021**
Allan M. and Arline B. Paul Physics Award, UW-Madison	**Jul 2021**
Admitted to the 5^{th} Summer School on ML in HEP with Grant, DESY, Hambrug, Germany	**Jul 2019**
1^{st} Prize for the project competition at the 44^{th} SLAC Summer Institute	**Aug 2016**
Honor Roll of CoS Elite Scholarship	**Sept 2013**
Honor Roll of CoS Chen-Wen Elite Scholarship	**Sept 2009**

Presentations

Conferences and Workshops

Contributed Talk, "Unbinned Profiled Unfolding", APS April Meeting, Minneapolis	**Apr 2023**
Invited Talk, "Serial powering for ATLAS ITk pixel modules", Pixel, Santa Fe	**Dec 2022**
Invited Seminar, "Search for the Higgs boson decaying to dimuon", Research Progress Meeting, LBNL, Berkeley	**Nov 2022**
Poster, "Search for the Higgs boson decaying to a pair of muons in pp collisions at 13 TeV with the ATLAS detector", ICHEP, Bologna	**Jul 2022**
Poster, "Search for the Higgs boson decaying to a pair of muons in pp collisions at 13 TeV with the ATLAS detector", LHCP, Taipei	**May 2022**
Poster, "Search for Dark Matter produced in association with a Standard Model Higgs boson decaying to b-quarks using the full Run 2 collision data with the ATLAS detector", LHCP, Taipei	**May 2022**
Invited Talk, "Search for rare and exotic decays of the Higgs boson in ATLAS", Pheno 2022, Pittsburg	**May 2022**

Contributed Talk, "Search for Dark Matter produced in association with a Higgs boson decaying to a pair of b quarks and combination of Dark Matter search with 2HDM+a with the ATLAS detector", APS April Meeting, New York **Apr 2022**

Invited Talk, "Searches for dark matter with the ATLAS detector", SUSY 2021, Online **Aug 2021**

Poster, "Search for Dark Matter produced in association with a Higgs boson decaying to a pair of b quarks at 13 TeV with the ATLAS detector', EPS-HEP, Online **Jul 2021**

Contributed Talk, "Search for the Higgs Boson Decaying to a Pair of Muons in pp Collisions at 13 TeV with the ATLAS Detector", DPF, Virtual **Jul 2021**

Invited Talk, "$H \to \mu\mu$, $H \to ee$ and $H \to e\mu$ in the Future", HZZ workshop, CERN **Nov 2020**

Young Scientist Forum, "Search for the Higgs Boson Decaying to a Pair of Muons in pp Collisions at 13 TeV with the ATLAS Detector", Higgs 2020, Online **Oct 2020**

Contributed Talk, "Dark Matter searches with the ATLAS Detector", NCTS Dark Physics Workshop, Hsinchu **Jan 2020**

Contributed Talk, "BDT Categorization in the Search of $H \to \mu\mu$", 4^{th} ATLAS Machine Learning Workshop, CERN **Nov 2019**

Contributed Talk, "Search for the Higgs Boson Decaying to a Pair of Muons in pp Collisions at 13 TeV with the ATLAS Detectorr", US ATLAS Physics Workshop, UMass Amherst **Aug 2019**

Contributed Talk, "Search for the Higgs Boson Decaying to a Pair of Muons in pp Collisions at 13 TeV with the ATLAS Detector", DPF, Northeastern University **Jul 2019**

Invited Talk, "Study of ITK-Pixel Chip and Hybrid Materials", ATLAS Upgrade Week, Pixel and Strip Software, CERN **Apr 2019**

Contributed Talk, "Improving Discrimination of VBF and ggH for Higgs coupling measurement at the LHC", Annual Meeting of the Physical Society of Republic of China (PSROC), Tamsui **Jan 2017**

Contributed Talk, "Accumulation of Dark Matter in the Sun and its implication", 4^{th} International Workshop on Dark Matter, Dark Energy and Matter-Antimatter Asymmetry, Hsinchu **Dec 2016**

Poster, "Dark matter induced MSW effects in the Sun", 44^{th} SLAC Summer Institute, SLAC **Aug 2016**

Contributed Talk, "Dark matter induced MSW effects in the Sun", Annual Meeting of the Physical Society of Republic of China, Kaohsiung **Jan 2016**

ATLAS Approval and ATLAS Plenary Talks

Higgs Approval for Higgs coupling combination analysis	**Sept 2021**
Analysis Presentation for 2HDM+a combination analysis at ATLAS Approval Meeting	**Jul 2021**
Analysis Presentation for monoHbb analysis at ATLAS Approval Meeting	**Feb 2021**
"Dark Matter Searches for Moriond & 2HDM+a Combination Plans", Exotics Plenary P&P Week, CERN	**Nov 2020**
Higgs Unblinding Approval for $H \to \mu\mu$ analysis	**May 2020**
Higgs Unblinding Closure for $H \to \mu\mu$ analysis	**Jun 2019**

Skills

Programming	Python, C/C++, Git, LaTeX, Bash, Mathematica, MySQL, C#
Machine Learning	BDT, Neural Network, RNN, Deep Sets, Attention, Transformer, GNN, Autoencoder, Variational Autoencoder, GAN, Normalizing Flow, XGBoost, Scikit-Learn, TensorFlow/Keras, PyTorch
Languages	Mandarin (native), English (fluent), Taiwanese (fluent), German (basic), French (basic)
Other	GitLab, GitHub, Docker, Electronics

Leadership

Nominated as **Analysis contact**, for 2HDM+a combination publication	**2022**
Liaison, between the monoHbb analysis team and the 2HDM+a combination team, ATLAS	**2020 - 2021**
Editor, 2HDM+a combination analysis support note, ATLAS	**2020 - 2021**
Editor, mono-$H(bb)$ analysis support note, ATLAS	**2019 - 2020**
Editor, ATLAS Higgs $\to \mu\mu$ search paper support note, ATLAS	**2019 - 2020**
Editor, ATLAS Higgs $\to \mu\mu$ search EPS 2019 support note, ATLAS	**2019**

Teaching

Teaching Assistant, Undergraduate Physics, UW-Madison **Sep 2017 - May 2018**

- Performance evaluated to be "Excellent" (top rating) with the score of 4.72/5.0 for Fall and 4.54 for Spring.

Teaching Assistant, Electromagnetism, NTHU	**Sep 2015 - Jun 2017**
Teaching Assistant, Quantum Mechanics, NTHU	**Sep 2014 - Jun 2015**
Teaching Assistant, Optics Lab, NTHU	**Sep 2013 - Jun 2014**
Teaching Assistant, Applied Electronics Lab, NTHU	**Sep 2012 - Jun 2013**

Outreach

Shared experience of studying abroad on social media (Instagram, Facebook), American Institute in Taiwan **Feb 2023**

Member of Lambda Alliance ERG, LBNL **Sept 2022 - Present**

- Participated in monthly ERG meeting.
- Participated in the 2022 San Francisco Pride Parade.

Introduced High Energy Particle Physics to the Wisconsin Taiwanese Student Association, "The smallest particle created by the largest experiment", UW-Madison **Sept 2020**

Presented a talk on High Energy Physics to high school students, "Are we in danger with the black holes created by LHC?", The Affiliated Senior High School of National Taiwan Normal University, Taipei **Dec 2019**

Member of CERN LGBT Club, CERN **May 2018 - Present**

- Organized the 2019 Geneva Pride activities.
- Organized the 2018 LGBTSTEM Day.

References

- Prof. Sau Lan Wu
  Enrico Fermi Professor of Physics, Vilas Professor, University of Wisconsin-Madison
  Fellow of American Academy of Arts and Sciences
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- Dr. Benjamin Nachman
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